



NETL Life Cycle Inventory Data

Process Documentation File

Process Name: Operation of NETL Baseline SubCPC Power Plant

Reference Flow: 1 MWh of Electricity

Brief Description: The operations of the NETL baseline Subcritical Pulverized Coal (SubCPC) power plants with or without carbon capture and sequestration (CCS) on the basis of 1 MWh electricity output.

Section I: Meta Data

Geographical Coverage: USA **Region:** Midwest

Year Data Best Represents: 2015

Process Type: Energy Conversion (EC)

Process Scope: Gate-to-Gate Process (GG)

Allocation Applied: No

Completeness: Individual Relevant Flows Captured

Flows Aggregated in Data Set:

☒ Process

☒ Energy Use

☐ Energy P&D

☐ Material P&D

Relevant Output Flows Included in Data Set:

Releases to Air: ☒ Greenhouse Gases ☒ Criteria Air ☐ Other

Releases to Water: ☐ Inorganic ☐ Organic Emissions ☒ Other

Water Usage: ☐ Water Consumption ☐ Water Demand (throughput)

Releases to Soil: ☐ Inorganic Releases ☐ Organic Releases ☐ Other

Adjustable Process Parameters:

CF

[dimensionless] Capacity Factor of SubCPC plant

CCS

[binary] If CO₂ in flue gas is routed to CO₂ recovery, value = 1. If CO₂ in flue gas is released to atmosphere, value = 0.

Life_time	<i>[Years] Life time of a power plant</i>
CF_AuxB	<i>[Dimensionless] Fraction of downtime that auxliary boiler operates</i>
NG_AuxB_tot_kg	<i>[kg/hr] Natural gas consumption for auxiliary boiler</i>

Tracked Input Flows:

SubCPC power plant [Construction]	<i>[Technosphere] SCPC power plant</i>
Hard Coal (Illinois No 6)	<i>[Technosphere] Coal for combustion</i>
Natural gas combustion in auxiliary boiler	<i>[Technosphere] Natural gas combusted in auxiliary boiler</i>
Activated carbon	<i>[Technosphere] Activated carbon consumption</i>
Limestone	<i>[Technosphere] limestone for treatment consumption</i>
Hydrate Lime	<i>[Technosphere] Hydrated lime consumption</i>
Ammonia [Material]	<i>[Technosphere] Ammonia consumption</i>
SCR catalyst [Material]	<i>[Technosphere] SCR catalyst consumption</i>
Triethylene glycol [Material]	<i>[Technosphere] Triethylene glycol consumption</i>
Makeup water treatment chemicals [Material]	<i>[Technosphere] Makeup water treatment chemicals</i>

Tracked Output Flows:

Power [Electric Power]	<i>Reference flow</i>
Gypsum	<i>By-product</i>
Carbon dioxide [Inorganic intermediate products]	<i>CO₂ captured for CCS</i>
Waste (unspecified)	<i>Waste</i>
Waste [Solid Waste]	<i>Solid Waste</i>

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage3_O_SubCPC_Power_Plant_Baseline_2015.01.xlsx*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

This unit process provides a summary of relevant input and output flows associated with the production of electricity by the combustion of coal in the subcritical pulverized coal power plants defined in the NETL baseline studies. This process can be used for scenarios with and without CCS. Key inputs include Illinois No. 6 coal, water from ground and municipal sources, and combustion of natural gas in an auxiliary boiler. Key outputs include electricity, greenhouse gas emissions to air, and waste water. The reference flow of this unit process is 1 MWh of Electricity. **Figure 1** illustrates the scope and boundary with key inputs and outputs.

Boundary and Description

The SubCPC plant is based on the NETL baseline of SubCPC power (NETL, 2013). Refer to the baseline studies for details regarding plant designs with and without CCS. The SubCPC process inputs, water usage, and emissions are calculated on a per unit basis using the results of the NETL baseline SubCPC plants, Cases B11A and B11B.

The plant produces two potential co-products. The capture plant produces a supercritical stream of CO₂ suitable for injection into a pipeline. Depending on the destination, the CO₂ can be treated as a co-product (e.g., CO₂ enhanced oil recovery). The second co-product is synthetic gypsum produced by the flue gas desulfurization equipment. Again, depending on the destination, it could be treated as a co-product; otherwise, it is a waste flow.

This process also includes a tracked input of natural gas used for auxiliary boiler operations. The auxiliary boiler operating time is assumed to be half of the SubCPC plant downtime, which is derived from the SubCPC plant capacity factor. The result is that the auxiliary boiler operates 7.5% of the plant life. To place the auxiliary boiler natural gas consumption on a MWh basis, the auxiliary boiler natural gas consumption is scaled down to 7.5% and then divided by the plant power output which operates with an 85% capacity factor. The emissions from the auxiliary boiler are calculated by a separate unit process.

Figure 1: Unit Process Scope and Boundary

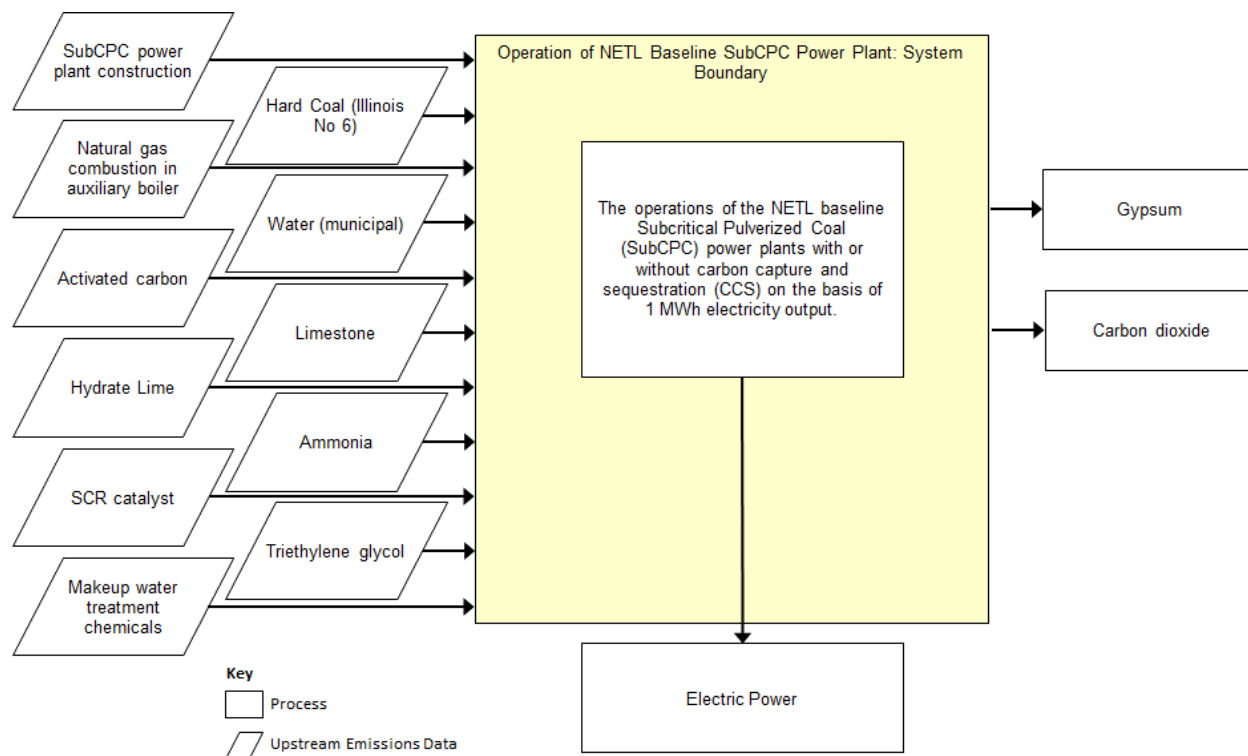


Table 2: Unit Process Input and Output Flows

Flow Name	Without CCS	with CCS	Units (Per Reference Flow)
Inputs			
SubCPC power plant [Construction]	8.13E-09	8.13E-09	kg
Hard Coal (Illinois No 6) [Hard coal (resource)]	3.40E+02	4.26E+02	kg
Natural gas combustion in auxiliary boiler	1.62E-01	1.62E-01	kg
Water (ground water) [Water]	1.14E+03	1.74E+03	L
Water (municipal) [Water]	1.14E+03	1.74E+03	L
Activated carbon	2.06E-01	2.75E-01	kg
Limestone	3.36E+01	5.58E+01	kg
Hydrated Lime	6.87E+00	8.59E+00	kg
Ammonia [Material]	4.95E+00	6.32E+00	kg
SCR catalyst [Material]	2.50E-02	3.11E-02	L
Triethylene glycol [Material]	0.00E+00	1.17E-01	L
Makeup water treatment chemicals [Material]	6.63E-01	1.01E+00	kg
Outputs			
Power [Electric Power]	1.00E+00	1.00E+00	
Gypsum [intermediate]	5.77E+00	7.28E+00	kg
Carbon dioxide [Inorganic intermediate products]	0.00E+00	9.10E+02	kg
Carbon dioxide [Inorganic emissions to air]	8.07E+02	1.01E+02	kg
Nitrogen oxides [Inorganic emissions to air]	3.35E-01	3.72E-01	kg
Sulphur dioxide [Inorganic emissions to air]	3.35E-01	0.00E+00	kg
Dust (unspecified) [Particles to air]	4.31E-02	4.78E-02	kg
Mercury (+II) [Heavy metals to air]	1.44E-06	1.59E-06	kg
Water (wastewater) [Water]	4.70E+02	7.93E+02	L
Waste (unspecified) [Waste]	0.00E+00	4.74E+00	kg
Waste [Solid Waste]	4.03E+01	5.05E+01	kg

* **Bold face** clarifies that the value shown *does not* include upstream environmental flows.

Embedded Unit Processes

None.

References

NETL. (2013). *Cost and Performance Baseline for Fossil Energy Plants, Volume 1: Bituminous Coal and Natural Gas to Electricity Report*. (DOE/NETL-2010/1397). Pittsburgh, PA: National Energy Technology Laboratory. Retrieved from http://www.netl.doe.gov/energy-analyses/pubs/BitBase_FinRep_Rev2.pdf.

Section III: Document Control Information

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